Apprenticeship and Industry Training

Agricultural Equipment Technician

Apprenticeship Course Outline

3206 (2006)

Alberta
Advanced Education
Apprenticeship and Industry Training

ALBERTA ADVANCED EDUCATION CATALOGUING IN PUBLICATION DATA

Alberta. Alberta Advanced Education. Apprenticeship and Industry Training.
Agricultural equipment technician apprenticeship course outline.

ISBN 0-7785-4764-7

1. Agricultural machinery - Maintenance and repair - Vocational guidance - Alberta.
2. Apprentices - Alberta. 3. Apprenticeship programs - Alberta. 4. Occupational training - Alberta.
I. Apprenticeship and Industry training (Series). II. Title.

HD4885.C2.A27.A333 2006 373.27

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2007-01443/

Agricultural Equipment Technician

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Course Outline

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Apprenticeship and Industry Training System

Apprenticeship is post-secondary education with a difference. It helps ensure Alberta has a steady supply of highly skilled employees, the foundation of our economy's future health and competitiveness.

Apprentices in more than 50 trades and crafts spend between one and four years learning their trade - 80% of the time on the job under the supervision of a certified journeyman or qualified tradesperson. The balance of the program is technical training in the theory, skills and technologies of their trade.

To become certified journeymen apprentices must learn theory and skills, and they must pass examinations. Requirements for certification—including the content and delivery of technical training—are developed and updated by the Alberta Apprenticeship and Industry Training Board (the Board) and a network of local and provincial industry committees.

The graduate of the Agriculture Equipment Technician apprenticeship training is a journeyman who will be able to:

- repair, diagnose and maintain by skill and knowledge gained through training and experience any of the working parts of diesel engines as well as the various components of mobile farm machinery.
- use, competently, both hand and power tools in order to carry out repairs according to manufacturer's specifications.
- read and understand work orders, prepare estimates, and interpret technical manuals.
- write service reports, diagnose the cause of failures and keep service analysis records.
- utilize the knowledge and may advance to service representatives or supervisory positions.
- be familiar with the work in related trades such as Heavy Equipment Technician, Machinist and Welder.

Apprenticeship and Industry Training Committee Structure

While government supports Alberta's apprenticeship and industry training system, it is driven by industry, a term which includes both employers and employees. The Alberta Apprenticeship and Industry Training Board, with the support of Alberta Advanced Education, oversees the system. But the system relies on a network of industry committees. These committees include local and provincial apprenticeship committees (LACs and PACs) in the designated trades and occupational committees (OCs) in the designated occupations, as well as other committees such as provisional committees established before the designation of a new trade or occupation comes into effect. All these committees are composed of equal numbers of employers and employees. The network of industry committees is the foundation of Alberta's apprenticeship and industry training system.

Local Apprenticeship Committees (LAC)

Wherever there is activity in a trade, the Board can set up a LAC. The Board appoints equal numbers of employees and employers for terms of up to three years. The committee appoints a member as presiding officer. Local Apprenticeship Committees:

- monitor the apprenticeship system, and the progress of apprentices in their trade, at the local level.
- help settle certain kinds of issues between apprentices and their employers.
- recommend improvements in apprenticeship training and certification to their trade's provincial apprenticeship committee.
- make recommendations to the Board regarding the appointment of members to their trade's PAC.

Provincial Apprenticeship Committees (PAC)

The Board establishes a PAC for each trade and, based on PAC recommendations, appoints a presiding officer and equal numbers of employees and employers for terms of up to three years. Most PACs have nine members. Provincial Apprenticeship Committees:

- identify the training needs and content for their trade.
- recommend to the Board the standards for training and certification for their trade.
- monitor the activities of local apprenticeship committees in their trade.
- make recommendations to the Board about the designation of trades and occupations.
- determine whether training of various kinds is equivalent to training provided in an apprenticeship program in the trade.
- may participate in resolving any apprenticeship-related disputes between employers and employees.

Agricultural Equipment Technician PAC Members

Mr. S. Zorn	Calgary	Presiding Officer
Mr. K. Brandics	Lethbridge	Employer
Mr. D. Seehagel	Edmonton	Employer
Mr. J. Spencer	Calgary	Employer
Mr. G. Winter	Fairview	Employer
Mr. L Brousseau	Vermilion	Employee
Mr. K. Demontigny	Edmonton	Employee
Mr. I. Henderson	Stettler	Employee
Mr. K. Wood	Barrhead	Employee

The Alberta Apprenticeship and Industry Training Board (Board)

The mandate of the Alberta Apprenticeship and Industry Training Board relates to the standards and requirements for training and certification in programs under the *Apprenticeship and Industry Training Act*. The Board provides advice to the Minister of Advanced Education on the training and certification of people in designated trades and occupations and on the needs of the Alberta labour market for skilled and trained persons. The Board also makes orders and regulations respecting standards and requirements for apprenticeship programs and the training of apprentices and for training and certification in designated trades and occupations, and the criteria or requirements for granting and recognizing trade and other certificates.
The 13-member Board consists of a chair, eight members representing trades and four members representing other industries. Employer and employee representatives equally represent the trades and other industry members.

Safety Education

Safe working procedures and conditions, accident prevention and the preservation of health are of primary importance in apprenticeship programs in Alberta. These responsibilities are shared and require the joint efforts of government, employers, employees and the public. Therefore, it is imperative that all parties become aware of circumstances that may lead to injury or harm. Safe learning experiences and environments can be created by controlling the variables and behaviors that may contribute to or cause an accident or injury.

It is generally recognized that a safe attitude contributes to an accident free environment. Everyone will benefit as a result of a healthy, safe attitude towards prevention of accidents.

A tradesperson is possibly exposed to more hazards than any other person in the work force and, therefore, should be familiar with and apply the Occupational Health and Safety Act and Regulations dealing with personal safety and the special safety rules applying to each task.

Legal and Administrative Aspects of Safety

Accident prevention and the provisions of safe working conditions are the responsibilities of an employer and employee.

Employer's Responsibilities

The employer is responsible for:

- providing and maintaining safety equipment and protective devices.
- ensuring proper safe work clothing is worn.
- enforcing safe working procedures.
- providing safeguards for machinery, equipment and tools.
- observing all accident prevention regulations.
- training employees in the safe use and operation of equipment.

Employee's Responsibilities

The employee is responsible for:

- working in accordance with the safety regulations pertaining to the job environment.
- working in such a way as not to endanger themselves or fellow employees.

Occupational Health and Safety's Responsibilities:

Occupational Health and Safety (Alberta Human Resources and Employment) will conduct periodic inspections of the workplace to ensure that safety regulations for industry are being observed.

Technical Training Establishment

Alberta Advanced Education, Apprenticeship and Industry Training offer your apprenticeship training program. Staff and facilities for delivering all four periods of the program are supplied by Olds College; second and fourth period are also offered at:

- Keyano College
- Lakeland College
- Lethbridge Community College
- Northern Alberta Institute of Technology (main campus)
- Northern Alberta Institute of Technology (Fairview campus)
- Red Deer College
- Southern Alberta Institute of Technology (main campus)

Procedures for Recommending Revisions to the Course Outline

Apprenticeship and Industry Training, Industry Programs and Standards has prepared this course outline in partnership with the Trade Name Provincial Apprenticeship Committee.

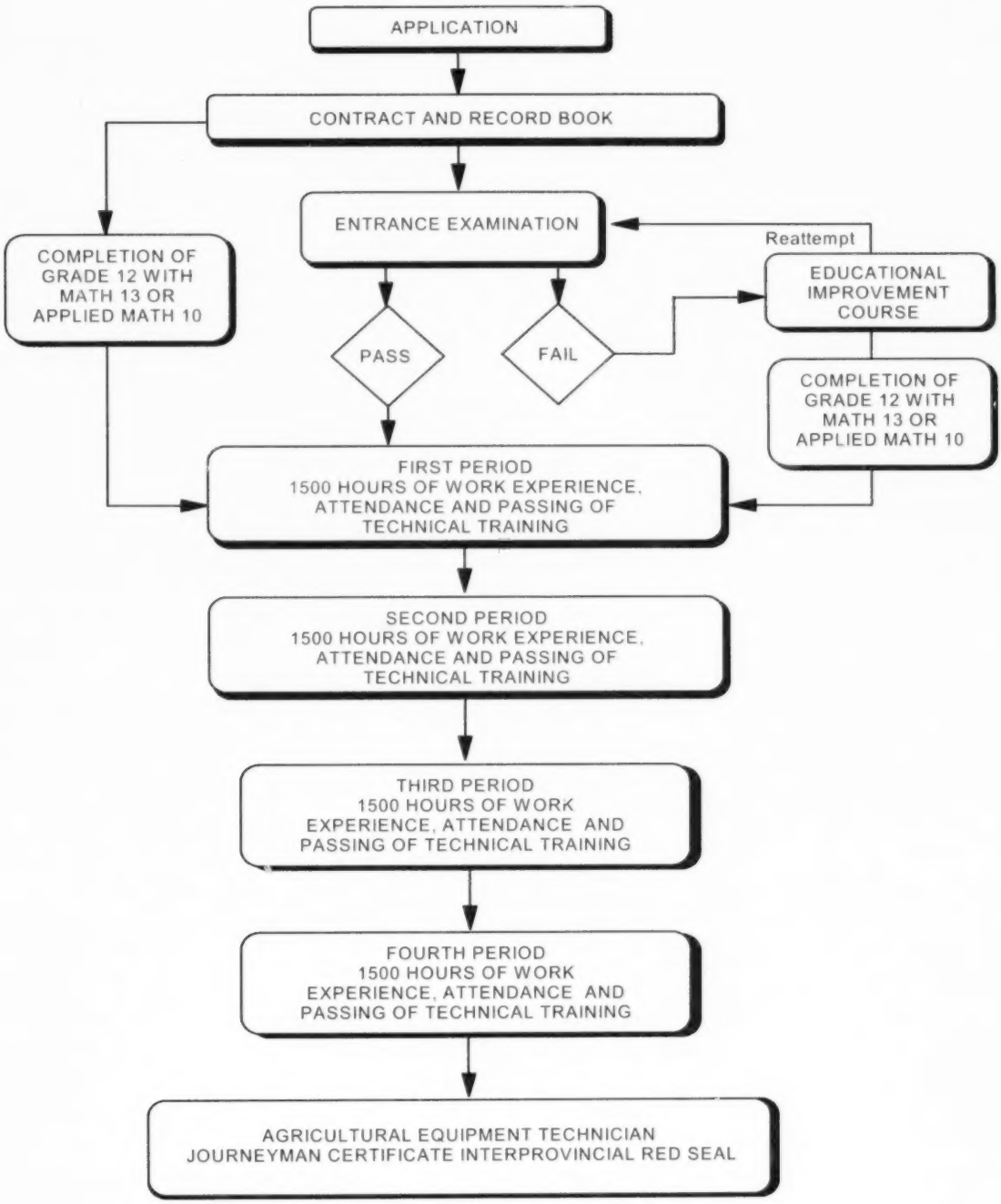
This course outline was approved on March 20, 2006 under the authority of the Alberta Apprenticeship and Industry Training Board on a recommendation from the Provincial Apprenticeship Committee. Valuable input is acknowledged from industry and the institutions.

Any concerned citizen or group in the Province of Alberta may make recommendations for change by writing to:

Agriculture Equipment Technician Provincial Apprenticeship Committee
c/o Industry Programs and Standards
Apprenticeship and Industry Training
10th floor, Commerce Place
10155 - 102 Street
Edmonton, AB T5J 4L5

It is requested that recommendations for change refer to specific areas and state references used. Recommendations received will be placed before regular meetings of the Provincial Apprenticeship Committee.

Apprenticeship Route toward Certification


APPLICATION
CONTRACT AND RECORD BOOK
ENTRANCE EXAMINATION
COMPLETION OF GRADE 12 WITH MATH 13 OR APPLIED MATH 10
Reattempt
EDUCATIONAL IMPROVEMENT COURSE
PASS
FAIL
COMPLETION OF GRADE 12 WITH MATH 13 OR APPLIED MATH 10
FIRST PERIOD 1500 HOURS OF WORK EXPERIENCE, ATTENDANCE AND PASSING OF TECHNICAL TRAINING
SECOND PERIOD 1500 HOURS OF WORK EXPERIENCE, ATTENDANCE AND PASSING OF TECHNICAL TRAINING
THIRD PERIOD 1500 HOURS OF WORK EXPERIENCE, ATTENDANCE AND PASSING OF TECHNICAL TRAINING
FOURTH PERIOD 1500 HOURS OF WORK EXPERIENCE, ATTENDANCE AND PASSING OF TECHNICAL TRAINING
AGRICULTURAL EQUIPMENT TECHNICIAN JOURNEYMAN CERTIFICATE INTERPROVINCIAL RED SEAL

Trade Name Training Profile

FIRST PERIOD
(8 Weeks 30 Hours per Week – Total of 240 Hours)

SECTION ONE

SAFETY, BASIC MATERIALS, TOOLS AND SKILLS
36 Hours

A	B	C
Safety, Housekeeping Practices and Lifting Procedures 8 Hours	Fire Prevention and, Fuel and Oil Storage 4 Hours	Communication 7 Hours
D	**E**	**F**
Materials, Fastening Devices and Sealing Systems 5 Hours	Precision Measuring Tools 8 Hours	Hand Tools 4 Hours

SECTION TWO

ELECTRIC WELDING AND OXY FUEL CUTTING
30 Hours

A	B	C
Welding Safety 3 Hours	Oxy-Fuel Equipment 9 Hours	SMAW (Shielded Metal Arc Welding) 10 Hours
D		
GMAW (Gas Metal Arc Welding) 8 Hours		

SECTION THREE

BASIC ELECTRICAL
54 Hours

A	B	C
Electrical Fundamentals 4 Hours	Magnetism Fundamentals 4 Hours	Voltage 6 Hours
D	**E**	**F**
Electrical Current 6 Hours	Electrical Resistance 6 Hours	Introduction to Lead-acid Battery 10 Hours
G		
Diagnostic Procedures 18 Hours		

SECTION FOUR

BASIC HYDRAULICS
30 Hours

A	B	C
Hydraulic Fundamentals 9 Hours	Hydraulic System Components: Reservoir, Filters, Hoses And Coolers 5 Hours	Hydraulic System Components: Pumps, Valves, Cylinders And Accumulators 7 Hours
D		
Hydraulic Systems 9 Hours		

SECTION FIVE

AGRICULTURAL EQUIPMENT
66 Hours

A	B	C
Tractor Performance 6 Hours	Suspensions & Steering Systems on Agricultural Equipment 8 Hours	Cutting Equipment (include all types of crop cutting equipment) 10 Hours
D	**E**	**F**
Baling Equipment 26 Hours	Tillage Implements 12 Hours	Other Types of Agricultural Equipment 4 Hours

SECTION SIX

POWER TRAIN I

24 Hours

⇨

A

Clutch Fundamentals and Service

9 Hours

B

Drive Line Fundamentals and Service

6 Hours

C

Gearing Principles

3 Hours

D

Drive Axle and Differential Fundamentals

6 Hours

SECOND PERIOD
(8 Weeks 30 Hours per Week – Total of 240 Hours)

SECTION ONE

ENGINE FUNDAMENTALS, SERVICE AND REPAIR
75 Hours

A	B	C
Engine Fundamentals 6 Hours	Engine Block And Cylinder Liner Fundamentals 6 Hours	Engine Block And Cylinder Liner Service 6 Hours
D	**E**	**F**
Piston, Piston Rings And Connecting Rod Fundamentals 6 Hours	Piston, Piston Rings And Connecting Rod Service 6 Hours	Crankshaft, Bearings And Related Component Fundamentals 6 Hours
G	**H**	**I**
Crankshaft, Bearings And Related Component Service 6 Hours	Camshaft And Follower Fundamentals 6 Hours	Camshaft And Follower Service 6 Hours
J	**K**	**L**
Cylinder Head Fundamentals 9 Hours	Cylinder Head Service 9 Hours	Engine Braking System Fundamentals And Service 3 Hours

SECTION TWO

ENGINE SYSTEMS
30 Hours

A	B	C
Air Induction And Exhaust Systems 6 Hours	Turbo Charged Air Systems 6 Hours	Lubrication Systems And Crankcase Ventilation 9 Hours
D		
Cooling Systems (Liquid And Air) 9 Hours		

SECTION THREE

DIESEL FUEL INJECTION SYSTEMS
40 Hours

A	B	C
Diesel Fuel And Storage Tanks (Machine And Bulk Storage) 3 Hours	Combustion Process And Starting Aids 4 Hours	Basic Fuel Injection System 3 Hours
D	**E**	**F**
Fuel System Service 5 Hours	Port/Helix Fuel Systems 6 Hours	Opposed Plunger Inlet Fuel Metering Systems 6 Hours
G	**H**	**I**
Diesel Fuel Injector Fundamentals And Service 6 Hours	Engine Governor Fundamentals And Service 6 Hours	Emergency Shut-down Systems 1 Hour

SECTION FOUR

ELECTRONICS FUEL MANAGEMENT
45 Hours

A	B	C
Electronic Fuel System Fundamentals 15 Hours	Electronic Controlled Fuel Injection Systems 12 Hours	Performance Analysis And Tune-up 18 Hours

SECTION FIVE

HEAVY DUTY CHARGING & CRANKING SYSTEMS

50 Hours

⇨

A	B	C
Charging System And Control Circuit Fundamentals 12 Hours	Charging System Testing And Service 18 Hours	Cranking System Fundamentals And Motor Drives 3 Hours
D	**E**	**F**
Cranking System Control Circuits 3 Hours	Cranking System Testing And Service 12 Hours	Non-Electric Cranking Systems 2 Hours

THIRD PERIOD
8 Weeks 30 Hours per Week – Total of 240 Hours)

SECTION ONE

SPRAYING EQUIPMENT — **30 Hours**

A	B	C
Safety — 6 Hours	Sprayer Systems — 8 Hours	Monitoring Equipment — 10 Hours

D	E
Suspension Systems for Spraying — 4 Hours	New Advances in Spraying Technology — 2 Hours

SECTION TWO

AIR CONDITIONING AND HEATING SYSTEMS — **33 Hours**

A	B	C
Air Conditioning Fundamentals — 7 Hours	HVAC Control Systems — 8 Hours	Air Conditioning Testing, Service and Retrofitting — 18 Hours

SECTION THREE

POWER TRAIN II AND PREVENTIVE MAINTENANCE — **53 Hours**

A	B	C
Hydraulic Clutches and Power Take-Off — 8 Hours	Heavy Duty Transmissions and Four Wheel Drives — 22 Hours	Tracked and Wheeled Tractor Final Drives — 10 Hours

D	E
Preventive Maintenance — 6 Hours	Failure and Oil Analysis — 7 Hours

SECTION FOUR

AGRICULTURAL HARVESTING EQUIPMENT — **38 Hours**

A	B
Forage Harvesting Equipment — 16 Hours	Combines — 22 Hours

SECTION FIVE

SEEDING EQUIPMENT, WORKPLACE COACHING SKILLS and ADVISORY NETWORK — **23 Hours**

A	B
Seeding Equipment — 18 Hours	Workplace Coaching Skills — 5 Hours

SECTION SIX

BRAKING SYSTEMS — **24 Hours**

A	B	C
Hydraulic Brakes System Fundamentals — 3 Hours	Hydraulic Brakes Systems (Drum and Disc) — 7 Hours	Hydraulic Brakes System Diagnosis and Service — 7 Hours

D
Hydraulic Brake Booster System Fundamentals and Service — 7 Hours

SECTION SEVEN

PRECISION FARMING SYSTEMS — **39 Hours**

A	B	C
GPS Mapping — 12 Hours	Yield Monitors — 8 Hours	Variable Rate Application — 8 Hours

D	E
Monitors and Sensors — 4 Hours	GPS Steering Guidance Systems — 7 Hours

FOURTH PERIOD

(8 Weeks 30 Hours per Week – Total of 240 Hours)

SECTION ONE

ADVANCED HYDRAULICS
114 Hours

A	B	C
Hydraulic Principles 9 Hours	Hydraulic Pump Fundamentals 9 Hours	Hydraulic Pump Service 12 Hours
D	**E**	**F**
Hydraulic Actuator Fundamentals 6 Hours	Hydraulic Actuator Service 9 Hours	Hydraulic Valve II 18 Hours
G	**H**	**I**
Hydraulic System Types 18 Hours	Hydraulic System Testing And Service 18 Hours	Electro-Hydraulics 15 Hours

SECTION TWO

STEERING AND SUSPENSION SYSTEMS & ACCESSORIES
34 Hours

A	B	C
Wheeled Equipment Steering Fundamentals And Service 10 Hours	Suspension System Fundamentals And Service 6 Hours	Off-Road Equipment Accessories And Attachments 6 Hours
D	**E**	
Off-road Electrical Circuit Fundamentals 6 Hours	Off-road Electrical Circuit Service 6 Hours	

SECTION THREE

POWER TRAIN III
92 Hours

A	B	C
Gearing Principles 3 Hours	Torque Converter Fundamentals And Service 9 Hours	Powershift And Automatic Transmission Mechanical/Electronic Components 14 Hours
D	**E**	**F**
Powershift And Automatic Transmission Control And Shifting 10 Hours	Hydraulic Retarder Fundamentals 3 Hours	Powershift And Automatic Transmission Testing And Service 10 Hours
G	**H**	**I**
Tracked Equipment Steering Fundamentals And Service 11 Hours	Undercarriage Systems Fundamentals And Service 11 Hours	Final Drive Fundamentals And Service (off road) 6 Hours
J	**K**	
Drive Axle and Differential Fundamentals & Service (off road) 12 Hours	Clutch Fundamentals and Service 3 Hours	

NOTE: The hours stated are for guidance and should be adhered to as closely as possible. However, adjustments must be made for rate of apprentice learning, statutory holidays, registration and examinations for the training establishment and Apprenticeship and Industry Training.

FIRST PERIOD TECHNICAL TRAINING
AGRICULTURAL EQUIPMENT TECHNICIAN TRADE
COURSE OUTLINE

UPON SUCCESSFUL COMPLETION OF THIS PROGRAM THE APPRENTICE SHOULD BE ABLE TO PERFORM THE FOLLOWING OUTCOMES AND OBJECTIVES.

Due to the nature of work of the Agricultural Equipment Technician, it is imperative that safety be taught on a continuous basis throughout the entire course.

SECTION ONE: ..... SAFETY, BASIC MATERIALS, TOOLS AND SKILLS ..... 36 HOURS

A. Safety, Housekeeping Practices and Lifting Procedures ..... 8 Hours

Outcome: Explain the safety responsibilities of the Agricultural Equipment Technician.

1. Describe the safety legislation that pertains to the Agricultural Equipment Technician trade.
2. Describe the requirements of the Farm Implement Act.
3. Describe safe shop housekeeping practices.
4. Describe the safe use of air and electrical power tools.
5. Describe personal safety equipment requirements and use.
6. Describe lifting, jacking and blocking procedures.

B. Fire Prevention and, Fuel and Oil Storage ..... 4 Hours

Outcome: Explain fire prevention and the environmentally correct handling of shop fluids.

1. Describe fire prevention and the hazards of the combustion process.
2. Describe environmental requirements for the handling, storage and disposal of used shop fluids.
3. Describe safe handling, storage and transportation of flammable fluids and compressed gases.

C. Communication ..... 7 Hours

Outcome: Explain techniques used to communicate service information to the customer.

1. Define standard terms used by an agricultural equipment technician.
2. Describe strategies for oral and written communication.
3. Use a computer for communication and information access.
4. Use service manuals to determine repair and safety.

D. Materials, Fastening Devices and Sealing Systems ..... 5 Hours

Outcome: Identify materials, fasteners and sealing systems commonly used in the trade.

1. Describe materials and fastening devices used in agricultural machinery.
2. Describe the selection, application, and storage of gaskets, sealers, adhesives and cleaners.

E. Precision Measuring Tools ..... **8 Hours**

Outcome: Use precision measuring tools calibrated in imperial and metric measure.

1. Describe the use of precision measuring tools.
2. Describe the care and storage of measuring tools.
3. Interpret the dimensions taken with precision measuring tools.

F. Hand Tools ..... **4 Hours**

Outcome: Describe the use and maintenance of hand tools.

1. Describe the use and maintenance of selected hand tools.
2. Describe the use and maintenance of air and electrical power tools.

SECTION TWO: ..... ELECTRIC WELDING AND OXY FUEL CUTTING ..... 30 HOURS

The instruction under this section is not meant to be the level of a proficient and skilled journeyman Welder. The intent is to train the apprentices to a level where they may operate the required equipment in a safe manner, and perform such operations of metal cutting and tack welding as to make temporary attachment of component parts, prior to the finish welding required by a certified journeyman Welder.

A. Welding Safety ..... **3 Hours**

Outcome: Describe methods to demonstrate personal safety.

1. Describe hazards associated with welding applications and activities.
2. Demonstrate the use of personal protective clothing and equipment.
3. Describe methods to protect other personnel in the area.

B. Oxy-Fuel Equipment ..... **9 Hours**

Outcome: Demonstrate the use of the torch for welding, heating, brazing and cutting.

1. Describe the characteristics and safe handling procedures for gases and cylinders.
2. Describe care and maintenance procedures for oxy-fuel outfit.
3. Demonstrate equipment setup, adjustment, and shut down procedures.
4. Demonstrate use of personal protective equipment and safe operating procedures.
5. Perform heating, welding, and cutting operations using oxy-fuel equipment.
6. Describe temperature indicators and the effect of heat on metal.

C. SMAW (Shielded Metal Arc Welding) ..... **10 Hours**

Outcome: Perform welding operations using arc welding equipment.

1. Define basic electricity terms related to arc welding.
2. Describe selected machine types, welding currents, and polarities.
3. Describe care and maintenance procedures of arc welding equipment.
4. Demonstrate equipment setup and adjustments.
5. Describe the electrode designation system.
6. Select electrodes for specific applications.
7. Describe arc welding puddle controls.
8. Demonstrate joint preparation and fit up.

9. Demonstrate use of personal protective equipment and safe operating procedures.
10. Perform basic welding techniques (single and multi pass fillets in horizontal and flat positions) using arc welding equipment.

D. GMAW (Gas Metal Arc Welding) ..... 8 Hours

Outcome: Perform welding operations using the MIG welding process.

1. Describe MIG welding components and process.
2. Describe MIG welding puddle controls.
3. Describe care and maintenance of MIG welding equipment.
4. Demonstrate set up and adjustment procedures for MIG welding.
5. Perform fillet welds on light gauge plate using the MIG welding process.

SECTION THREE: ..... BASIC ELECTRICAL ..... 54 HOURS

NOTE: All electrical training is to emphasize trouble shooting and the reading of schematics.

A. Electrical Fundamentals ..... 4 Hours

Outcome: Apply scientific principles to explain electrical theory.

1. Explain the physical properties of conductors, insulators and semi-conductors.
2. Explain electricity in terms of voltage, current and resistance.

B. Magnetism Fundamentals ..... 4 Hours

Outcome: Apply scientific principles to explain the theory of magnetism.

1. Explain the fundamental laws of magnetism.
2. Explain the properties and applications of permanent magnets.
3. Explain the construction, operation, and applications of electromagnets.
4. Explain the principles of electromagnetic induction.

C. Voltage ..... 6 Hours

Outcome: Use electrical test equipment to measure electrical voltage.

1. Explain the construction and operation of voltmeters.
2. Measure electrical voltage.
3. Calculate and measure voltage drops in electrical circuits.
4. Demonstrate safe operation of voltmeters.

D. Electrical Current ..... 6 Hours

Outcome: Use electrical test equipment to measure electrical current (amperes).

1. Calculate electrical amperage.
2. Explain the construction and operation of ammeters.
3. Measure electrical current.
4. Demonstrate precautions while using ammeters.

E. Electrical Resistance ..... 6 Hours

Outcome: Use electrical test equipment to measure electrical resistance (ohms).

1. Calculate electrical resistance.
2. Explain the construction operation of ohmmeters.
3. Use an ohmmeter to measure electrical resistance.
4. Demonstrate precautions while using ohmmeters.

F. Battery Fundamentals and Service ..... 10 Hours

Outcome: Service, test and storage of agricultural batteries.

1. Identify hazards encountered with the use of batteries.
2. Explain battery construction, sizing and capacity.
3. Perform battery maintenance and testing.
4. List safety precautions and procedures for boosting batteries.
5. List safety precautions and procedures for charging batteries.
6. Explain multiple battery circuits in relation to connections and battery compatibility.

G. Diagnostic Procedures ..... 18 Hours

Outcome: Interpret electrical circuit schematics.

1. Identify commonly used schematic symbols.
2. Explain simple electrical schematic drawings.
3. Identify commonly used electrical weather and non-weather sealed connections.
4. Demonstrate wiring and connection repairs.
5. Use appropriate test equipment to test simple machine circuits.
6. Explain precautions related to accessories and electronics when servicing electrical circuits.

SECTION FOUR: ..... BASIC HYDRAULICS ..... 30 HOURS

A. Hydraulic Fundamentals ..... 9 Hours

Outcome: Explain hydraulic principles used on agricultural equipment.

1. Define hydraulic terminology.
2. Using mathematical calculations, explain the hydraulic principles of pressure, force, area, volume, flow rate, cycle times and power.
3. Draw and interpret basic hydraulic schematics.
4. State the safety precautions that must be observed when working with hydraulic systems.

B. Hydraulic System Components: Reservoir, Filters, Hoses And Coolers ..... 5 Hours

Outcome: Explain the function of the following hydraulic system components; hydraulic oils, reservoirs, filters, conductors, and heat exchangers.

1. Explain the properties of hydraulic fluid and the criteria for its selection.
2. State the functions of the hydraulic reservoir and its related components.
3. State the functions and principles of operation of filtration devices.
4. Explain the construction and applications of common types of hydraulic conductors.

5. State the functions and applications of hydraulic heat exchangers.

C. Hydraulic System Components: Pumps, Valves, Cylinders And Accumulators ..... 7 Hours

Outcome: Explain the functions and principles of operation of hydraulic system components.

1. Explain hydraulic sealing methods.
2. Explain gear pump operating principles.
3. State the function and principles of operation for a direct acting pressure relief valve.
4. Explain the principles of operation and applications of hydraulic control valves.
5. Explain the principles of operation and applications of basic hydraulic cylinders.
6. Explain the principles of operation and applications of basic hydraulic accumulators.

D. Hydraulic Systems ..... 9 Hours

Outcome: Explain the fundamental operating characteristics of hydraulic systems used in agricultural equipment.

1. Explain the operating principles of an open centre hydraulic system.
2. Explain the operating principles of a closed centre hydraulic system.
3. Explain the operating principles of a closed centre load sensing hydraulic system.
4. Perform a basic hydraulic system pressure and flow test.

SECTION FIVE: ..... AGRICULTURAL EQUIPMENT ..... 66 HOURS

A. Tractor Performance ..... 6 Hours

Outcome: Identify factors that influence tractor field performance.

1. Define tractor horsepower concepts.
2. Calculate drawbar horsepower requirements.
3. Describe and calculate slippage.
4. Describe Power Hop and its control.
5. Calculate ballasting solutions for tractors.
6. Compare the use of tires and rubber tracks.
7. Interpret Nebraska tests.

B. Suspensions and Steering Systems on Agricultural Equipment ..... 8 Hours

Outcome: Explain suspensions and steering systems on agricultural equipment.

1. Describe suspension systems used on wheeled agricultural equipment.
2. Describe steering systems used on wheeled agricultural equipment.
3. Describe service of wheels, tires, and hubs.
4. Describe steering and suspension systems used on rubber track equipped agricultural equipment.

C. Cutting Equipment (include all types of crop cutting equipment) ..... 10 Hours

Outcome: Describe and adjust cutting equipment.

1. Describe the operation of a reciprocating knife mower.
2. Perform adjustments and repairs to a reciprocating knife mower.

3. Describe the operation of a rotary disc mower.
4. Perform adjustments and repairs to a disc type mower.
5. Describe types of hay conditioners.
6. Perform adjustments to hay conditioners.
7. Identify reel types and components.
8. Describe adjustments to reels.

D. Baling Equipment ..... 26 Hours

Outcome Describe and adjust hay baling equipment.

1. Describe the basic procedure of dry hay production.
2. Describe operation and construction of fixed chamber balers.
3. Describe operation and construction of variable chamber balers.
4. Describe operation and construction of balers used for haylage.
5. Perform adjustments and repairs to round balers.
6. Adjust baler monitor systems.
7. Describe operation and construction of small square balers.
8. Perform adjustments and repairs to small square balers.
9. Perform adjustments to knotters.
10. Describe operation and construction of large square balers.
11. Describe adjustments to large square balers.
12. Describe baler accessories.

E. Tillage Implements ..... 12 Hours

Outcome: Describe the components and usage of selected types of tillage equipment.

1. Define common tillage terms.
2. Describe tillage practices.
3. Describe types and components of cultivators.
4. Describe soil engaging tools used on cultivators.
5. Analyze the levelling controls used on cultivators
6. Describe the shank protection used on cultivators.
7. Explain the operation of disc implements.
8. Describe other selected tillage equipment.
9. Interpret Ag-Tech Centre (PAMI) reports.

F. Other Types of Agriculture Equipment ..... 4 Hours

Outcome: Describe adjustments and repairs of other selected types of equipment.

1. Describe adjustments and repairs of selected short-line and materials-handling equipment.

SECTION SIX: ..... POWER TRAIN I ..... 24 HOURS

A. Clutch Fundamentals and Service ..... 9 Hours

Outcome: Service and diagnose common clutch types.

1. Explain the function and operating principles of spring loaded clutch systems.
2. State the function of spring loaded clutch components.
3. Diagnose spring loaded clutch operating.
4. Perform service procedures for spring loaded friction clutches.
5. Explain the operation and maintenance of over-centre clutches.
6. Explain the operation principles of overrunning, dog, cone and bevel clutches.
7. Explain the operating principles of electromagnetic clutches.

B. Drive Line Fundamentals and Service ..... 6 Hours

Outcome: Diagnose and service drive lines and universal joints.

1. Explain the function and operating principles of common drive line assemblies.
2. Explain the construction and design features of common drive line components.
3. Diagnose and service universal joints.
4. Explain driveline phasing and angle limitations.
5. Check drive line phasing and angles.

C. Gearing Principles ..... 3 Hours

Outcome: Explain basic gearing principles.

1. Define gear terminology.
2. Explain gear relationships with regards to ratios and input/output direction.
3. Identify common gear types and applications.

D. Drive Axle and Differential Fundamentals ..... 6 Hours

Outcome: Explain the functions and operating principles of drive axle assemblies.

1. State the functions of a drive axle assembly.
2. Identify single reduction drive axle configurations.
3. Identify single reduction drive axle components.
4. Explain the operating principles of a single reduction drive axle and differential assembly.
5. Identify common types of differential units used in the trade.
6. Explain common axle shaft configurations.
7. Explain the lubrication of a single reduction drive axle .

SECOND PERIOD TECHNICAL TRAINING
AGRICULTURAL EQUIPMENT TECHNICIAN TRADE
COURSE OUTLINE

UPON SUCCESSFUL COMPLETION OF THIS PROGRAM THE APPRENTICE SHOULD BE ABLE TO PERFORM THE FOLLOWING OUTCOMES AND OBJECTIVES.

SECTION ONE: ..... ENGINE FUNDAMENTALS, SERVICE AND REPAIR ..... 75 HOURS

A. Engine Fundamentals ..... 6 Hours

Outcome: ***Explain the operating principles and design features of two and four stroke internal combustion engines.***

1. Explain the stages of development of the internal combustion engine.
2. Explain common engine terms and definitions.
3. Explain common methods of classifying engines.
4. Explain the principles of operation for two and four stroke cycle engines.
5. Compare diesel and gasoline engine operation.

B. Engine Block And Cylinder Liner Fundamentals ..... 6 Hours

Outcome: ***Describe the functions and design features of cylinder block assemblies.***

1. State the functions of the engine cylinder block.
2. Identify cylinder block construction and design features.
3. Describe the construction and design features of removable cylinder liners.

C. Engine Block and Cylinder Liner Service ..... 6 Hours

Outcome: ***Inspect an engine block assembly for serviceability.***

1. Inspect engine block for cracks, thread, bearing bore and machined surface condition.
2. Explain cylinder block repair procedures for cracks, threads, bearing bores and machined surfaces.
3. Explain inspection and reconditioning procedures for a cylinder block with integral cylinders.
4. Perform removable cylinder liner service.

D. Piston, Piston Rings And Connecting Rod Fundamentals ..... 6 Hours

Outcome: ***Describe the functions and design features of pistons, piston rings and connecting rods.***

1. Explain the function, construction and design features of pistons and piston pins.
2. Explain the function, construction and design features of piston rings.
3. Explain the function, construction and design features of connecting rods.

E. Piston, Piston Rings and Connecting Rod Service ..... 6 Hours

Outcome: Service a piston and connecting rod assembly.

1. Remove and disassemble piston and connecting rod assemblies.
2. Inspect piston and pin for reuse.
3. Explain connecting rod service procedures.
4. Install piston and connecting rod assemblies.

F. Crankshaft, Bearings and Related Component Fundamentals ..... 6 Hours

Outcome: Describe the functions and design features of crankshafts and their related components.

1. Explain the function and design features of crankshafts.
2. Explain methods used to achieve engine balance.
3. State the functions of crankshaft seals, gears and flywheels.
4. Describe the function and design features of friction bearings specific to engines.
5. Explain the lubrication principles of engine friction bearings.

G. Crankshaft, Bearings and Related Component Service ..... 6 Hours

Outcome: Service crankshafts, friction bearings and related components.

1. Remove crankshaft and bearings from an engine block.
2. Inspect and measure crankshafts to determine serviceability.
3. Inspect flywheel and vibration damper to determine serviceability.
4. Identify common crankshaft and bearing failures.
5. Install crankshafts and related components.

H. Camshaft And Follower Fundamentals ..... 6 Hours

Outcome: Describe the functions and design features of camshafts and related components.

1. Explain the function and design features of camshafts, camshaft bearings and seals.
2. Explain the function and design features of camshaft followers.
3. Explain camshaft drive mechanisms and timing.

I. Camshaft and Follower Service ..... 6 Hours

Outcome: Service camshaft and related components.

1. Remove camshaft and related components from an engine block.
2. Inspect and measure camshafts and related components to determine serviceability.
3. Install camshaft and related components.

J. Cylinder Head Fundamentals ..... 9 Hours

Outcome: Describe the functions and design features of cylinder heads and valve train components.

1. Explain the function, construction and design features of cylinder heads.
2. Describe the construction and design features of engine valves and related components.
3. Describe the construction and design features of valve train components.
4. Identify cylinder head sealing and retention devices.

K. Cylinder Head Service ..... 9 Hours

Outcome: Service cylinder heads and valve train components.

1. Demonstrate cylinder head removal and disassembly.
2. Clean and inspect cylinder heads.
3. Explain cylinder head and valve reconditioning procedures.
4. Inspect valve train components.
5. Demonstrate cylinder head assembly and installation.

L. Engine Braking System Fundamentals and Service ..... 3 Hours

Outcome: Explain the operation of engine compression and exhaust brakes.

1. State the function of an engine brake.
2. Explain the operation of an engine compression brake.
3. Explain basic adjustment and diagnosis of an engine compression brake.
4. Explain the functions and operation of an engine exhaust brake.

SECTION TWO: ..... ENGINE SYSTEMS ..... 30 HOURS

A. Air Induction and Exhaust Systems ..... 6 Hours

Outcome: Service air induction, exhaust systems and related components.

1. State the functions of an air induction system.
2. Identify and state the function of air induction system components.
3. State the function of an exhaust system.
4. Identify and explain the operation of exhaust system components.
5. Explain the service procedures for air induction and exhaust systems.
6. Explain the use of test equipment to measure air inlet restriction and exhaust backpressure.

B. Turbo Charged Air Systems ..... 6 Hours

Outcome: Service turbo charged air induction systems.

1. State the purposes for turbo charging the engine air induction system.
2. Explain the construction and operation of a turbo charged air induction system and components including Exhaust Gas Recirculation (EGR) systems.
3. Test, inspect and service a turbocharger.
4. Explain the function, construction and testing procedures for typical aftercoolers/intercoolers.
5. Explain the function of variable displacement turbo technology and wastegate systems.

C. Lubrication Systems And Crankcase Ventilation ..... 9 Hours

Outcome: Service lubrication systems and related components.

1. State the functions and characteristics of engine oil.
2. Describe the use of oil analysis as a diagnostic tool.
3. Explain the operating principles of a typical lubrication system and related components.
4. State the purpose of crankcase ventilation systems.
5. Perform lubrication system inspection and service.
6. Diagnose and repair faults related to lubrication systems and components.

D. Cooling Systems (Liquid And Air) ..... 9 Hours

Outcome: Service liquid and air-cooling systems and related components.

1. Explain the function of the engine cooling system.
2. Explain the operation and maintenance of an air-cooling system.
3. Explain the operation of a typical liquid cooling system and its components.
4. Perform engine liquid cooling system repair and maintenance.
5. Explain the functions and design features of temperature sensors and warning devices.

SECTION THREE: ..... DIESEL FUEL INJECTION SYSTEMS ..... 40 HOURS

A. Diesel Fuel And Storage Tanks (Machine And Bulk Storage) ..... 3 Hours

Outcome: Handle and store diesel fuel using safe and efficient practices.

1. State the safety precautions, characteristics and properties of diesel fuel.
2. Explain diesel fuel storage concerns.
3. Identify construction requirements and design features of fuel storage and supply tanks.

B. Combustion Process and Starting Aids ..... **4 Hours**

Outcome: Apply the theory of the combustion process to engine operation and diagnosis.

1. Explain the characteristics and factors affecting the diesel engine combustion process.
2. Explain diesel engine emission concerns.
3. Identify and state the purpose of common combustion chambers.
4. Identify types and function of common diesel engine starting aids.

C. Basic Fuel Injection System ..... **3 Hours**

Outcome: Explain the operation of a basic fuel injection system.

1. List the requirements of a fuel injection system.
2. Identify the layout and components of a basic fuel injection system.
3. Explain the function of the components required in the basic diesel fuel injection system.

D. Fuel System Service ..... **5 Hours**

Outcome: Service the fuel injection supply system.

1. Identify types and service procedures for common fuel filters.
2. Explain the operating principles and design features of common fuel transfer pumps.
3. Perform testing and diagnosis of a fuel transfer system.
4. Explain fuel transfer pump inspection and service procedures.

E. Port/Helix Metering Fuel Systems ..... **6 Hours**

Outcome: Service port/helix metering fuel injection systems.

1. Explain the principles of port and helix fuel metering.
2. Explain two methods of timing port and helix fuel injection pumps.
3. Describe emission controls used with port and helix injection pumps.

F. Opposed Plunger Inlet Fuel Metering Systems ..... **6 Hours**

Outcome: Service opposed plunger inlet metering fuel injection systems.

1. Explain the principle of inlet fuel metering for opposed plunger pump designs.
2. Explain the basic methods of timing opposed plunger pumps.
3. Describe emission controls used with opposed plunger pumps.

G. Diesel Fuel Injector Fundamentals And Service ..... 6 Hours

Outcome: Perform fuel injector testing, removal and replacement.

1. Identify hydraulic fuel injector types and construction.
2. Explain the operating principles of hydraulic fuel injection nozzles.
3. Describe fuel injector removal and replacement procedures.
4. Explain hydraulic injector testing procedures.
5. Demonstrate the procedure to isolate a faulty fuel injector on a running engine.

H. Engine Governor Fundamentals And Service ..... 6 Hours

Outcome: Explain governor operation and adjustments.

1. State the functions of engine governors.
2. Explain standard governor terminology.
3. Explain governor operation according to design characteristics and application.
4. Explain causes and symptoms of basic engine governor malfunctions.
5. Explain governor adjustment limitations and adjustments.

I. Emergency Shut-down Systems ..... 1 Hour

Outcome: Explain the operating principles of engine shutdown and warning systems.

1. Explain the operation of an engine emergency warning and shut down system that monitors oil pressure, coolant temperature, coolant level and engine over-speed.

SECTION FOUR: ..... ELECTRONICS FUEL MANAGEMENT ..... 45 HOURS

A. Electronic Fuel System Fundamentals ..... 15 Hours

Outcome: Retrieve and interpret basic diagnostic information from a typical diesel engine electronic control system.

1. Explain the operation of a computer controlled fuel injection system.
2. Explain the operation of engine sensors that measure pressure, temperature, speed, fluid level, and throttle position.
3. Explain integral warning, shutdown and fault codes systems used with electronic controls.
4. Demonstrate the use of a Personal Computer (PC) and other appropriate tools for electronic system interface.
5. Demonstrate the adjustment of electronic fuel control system parameters.

B. Electronically Controlled Fuel Injection Systems ..... 12 Hours

Outcome: Identify and explain components of electronically controlled fuel injection systems.

1. Explain the operation of an electronic unit fuel injection system.
2. Explain the operation of a HEUI fuel injection system.
3. Explain the operation of a common rail fuel injection system.
4. Explain the operation of an electronic unit pump fuel injection system.

C. Performance Analysis And Tune-up ..... 18 Hours

Outcome: Diagnose and service electronic controlled diesel fuel injection systems.

1. Explain the benefits of maintaining engine adjustments.
2. Explain engine performance testing and demonstrate diagnosis.
3. Diagnose and repair an electronic fuel control system malfunction.
4. Demonstrate removal and installation procedures of an electronic fuel pump or injector.

SECTION FIVE: ..... HEAVY DUTY CHARGING & CRANKING SYSTEMS ..... 50 HOURS

A. Charging System And Control Circuit Fundamentals ..... 12 Hours

Outcome: Explain the operation of 12 and 24 volt charging systems.

1. Explain the purpose of the charging system in relation to equipment operation.
2. Identify charging system components.
3. Describe the operational characteristics of an alternator.
4. Identify and state the function of common alternator components.
5. Describe the operation of an alternator in regards to induction, rectification and output control.
6. Identify and state the function of common alternator components.
7. Identify common regulator types and designs.
8. State the purpose of auxiliary terminals on integrally regulated alternators.
9. Explain the operation of charging system indicator circuits.

B. Charging System Testing And Service ..... 18 Hours

Outcome: Diagnose and service 12 and 24 volt charging systems.

1. Perform on-equipment charging system tests.
2. Demonstrate the procedure to bench test an alternator for output and voltage control.
3. Identify alternator defects.
4. Demonstrate charging system maintenance procedures.

C. Cranking System Fundamentals and Motor Drives ..... 3 Hours

Outcome: Explain the operation of 12 and 24 volt cranking systems.

1. Identify components of a typical cranking system.
2. Describe the principles of operation of a cranking motor.
3. Identify cranking motor construction in regards to electrical design.
4. Identify and state the function of common cranking motor components.
5. Identify and explain the operation of overrunning clutch type motor drives.
6. Explain operational limitations of a cranking motor.

D. Cranking System Control Circuits ..... 3 Hours

Outcome: Explain the operation of cranking motor control circuits.

1. Trace a starting system circuit diagram.
2. Explain the operation of a cranking motor solenoid switch.
3. Explain the operation of a magnetic switch.

E. Cranking System Testing And Service ..... 12 Hours

Outcome: Diagnose and service cranking systems.

1. Perform on-equipment cranking system tests.
2. Identify cranking motor defects by no-load test results.
3. Demonstrate the procedure to bench test and overhaul a cranking motor.
4. Identify possible cranking system failures from specific symptoms.

F. Non-Electric Cranking Systems ..... 2 Hours

Outcome: Service and maintain air and hydraulic cranking systems.

1. State the function, system requirements and troubleshooting procedures required on air cranking systems.
2. State the function, system requirements and troubleshooting procedures required on hydraulic motor cranking systems.

THIRD PERIOD TECHNICAL TRAINING
AGRICULTURAL EQUIPMENT TECHNICIAN TRADE
COURSE OUTLINE

UPON SUCCESSFUL COMPLETION OF THIS PROGRAM THE APPRENTICE SHOULD BE ABLE TO PERFORM THE FOLLOWING OUTCOMES AND OBJECTIVES.

Due to the nature of work of the Agricultural Equipment Technician, it is imperative that safety be taught on a continuous basis throughout the entire course.

SECTION ONE: .....SPRAYING EQUIPMENT.....30 HOURS

A. Safety ..... 6 Hours

Outcome Describe safe practices when working with and around agricultural chemicals.

1. Describe the rating system, which assesses agricultural chemical toxicity.
2. Describe safe transport, handling, and disposal of chemical containers.
3. Describe potential field application difficulties.
4. Describe environmental systems and clothing used to protect the operator when handling chemicals.

B. Sprayer Systems ..... 8 Hours

Outcome: Describe the operation of sprayer systems.

1. Describe the components of basic sprayer systems.
2. Explain the operation of a sprayer system.
3. Describe selected nozzles.
4. Interpret application charts.
5. Perform stationary calibrations

C. Monitoring Equipment ..... 10 Hours

Outcome: Program electronic devices used in the agricultural spraying industry.

1. Describe controllers used to monitor and adjust sprayer functions.
2. Program and calibrate a sprayer electronic rate controller.
3. Diagnose basic operating problems of a sprayer rate controller.
4. Describe GPS applications in spraying.

D. Suspension Systems for Spraying ..... 4 Hours

Outcome: Explain suspension system features used on high-clearance sprayers.

1. Describe suspension systems used to support sprayer booms.
2. Describe the methods utilized to adjust wheel tread spacing on high clearance sprayers.

E. New Advances in Spraying Technology ..... 2 Hours

Outcome Identify technical advances in the agricultural spraying industry.

1. Describe the operating principles of electrostatic spraying.
2. Describe the principles of camera controlled sprayer operation as outlined by research activities.

SECTION TWO: ..... AIR CONDITIONING AND HEATING SYSTEMS ..... 33 HOURS

A. Air Conditioning Fundamentals ..... 7 Hours

Outcome: Explain the operating principles of basic air conditioning systems.

1. Explain the thermodynamic principles related to air conditioning.
2. Explain the properties and handling precautions of refrigerants and refrigerant oils.
3. Identify the basic components of an air conditioning system.
4. Explain the operation of a cycling clutch air conditioning system using an expansion valve.

B. HVAC Control Systems (Heating, Ventilation and A/C) ..... 8 Hours

Outcome: Explain the operating principles of HVAC (Heating Ventilation and Air Conditioning) control systems.

1. Identify the components of an air conditioning control system.
2. Explain the operation of air conditioning control systems.
3. Identify the components of an air distribution system.
4. Explain the operation of an air distribution system.
5. Explain the procedure to test HVAC control system operation.

C. Air Conditioning Testing, Service and Retrofitting ..... 18 Hours

Outcome: Diagnose and service air conditioning systems.

1. State the safety precautions required when servicing air conditioning systems.
2. Identify air conditioning service tools.
3. Perform air conditioning system diagnosis.
4. Perform air conditioning service within legislated guidelines.
5. Explain replacement procedures for defective air conditioning components.
6. Describe the procedure for retrofitting A/C hoses.
7. Describe the procedure for retrofitting receiver dryers.
8. Describe the procedure for retrofitting compressors.
9. Describe the procedure for retrofitting expansion valves.
10. Describe the use of alternative refrigerants.

SECTION THREE: ..... POWER TRAIN II AND PREVENTIVE MAINTENANCE ..... 53 HOURS

A. Hydraulic Clutches and Power Take-off ..... 8 Hours

Outcome: Identify, diagnose, and repair hydraulic clutches and power take-offs.

1. Identify the components of a hydraulic clutch.
2. Explain the principles of operation of hydraulic clutches.
3. Perform service and diagnostic procedures of hydraulic clutches.
4. Identify types and designs of PTOs.
5. Describe principles of operation of PTOs.
6. Perform service and diagnostic procedures for PTOs.

B. Heavy Duty Transmissions and Four Wheel Drives ..... 22 Hours

Outcome: Identify and repair heavy duty mechanical transmissions and four wheel drive units.

1. Discuss heavy duty transmission nomenclature.
2. Identify design and types of transmissions.
3. Describe power flow, gear ratios, and shift procedures of transmissions.
4. Discuss service and diagnostic procedures of transmissions.
5. Discuss four wheel drive nomenclature and principles of operation.
6. Describe power flow and shift procedures through four wheel drive transfer unit s.
7. Describe power flow and shift procedures through four wheel drive axles.
8. Perform service and diagnostic procedures of four wheel drive power trains.

C. Tracked and Wheeled Tractor Final Drives ..... 10 Hours

Outcome: Identify and repair tracked and wheeled tractor final drives.

1. Discuss principles of operation.
2. Identify components.
3. Describe power flow through final drives.
4. Identify special tooling required.
5. Perform service and diagnostic procedures of final drives.

D. Preventive Maintenance ..... 6 Hours

Outcome: Explain typical maintenance programs used with agricultural equipment.

1. Explain the types of maintenance systems.
2. Explain the principles of preventive maintenance.
3. Explain the principles of predictive maintenance.
4. Demonstrate basic preventive maintenance and service procedures.

E. Failure and Fluid Analysis ..... 7 Hours

Outcome: Explain predictive maintenance procedures utilizing failure and fluid analysis.

1. Explain fluid (oil and coolant) analysis.
2. Explain basic failure analysis.

SECTION FOUR: ..... AGRICULTURAL HARVESTING EQUIPMENT ..... 38 HOURS

A. Forage Harvesting Equipment ..... 16 Hours

Outcome: Describe and adjust forage harvesters.

1. Describe the basic procedure of silage making.
2. Describe the operation of forage harvesters.
3. Perform adjustments and repairs to forage harvesters.
4. Describe repair procedures for metal detection systems.

B. Combines ..... 22 Hours

Outcome: Describe and adjust combines.

1. Describe the functions of a combine.
2. Describe the differences between conventional and rotary combines.
3. Describe components of conventional combines.
4. Describe components of rotary combines.
5. Describe the in-field trouble-shooting and adjustments of combines.
6. Perform adjustments and repairs to combines.

SECTION FIVE: ..... SEEDING EQUIPMENT, ... 23 HOURS
WORKPLACE COACHING SKILL AND ADVISORY NETWORK

A. Seeding Equipment ..... 18 Hours

Outcome: Describe and adjust seeding equipment.

1. Describe basic seeding theory.
2. Identify selected types of seeding equipment.
3. Describe the basic operating procedures of seeding equipment.
4. Identify selected types of soil openers and their seed placement.
5. Describe styles of seed metering systems.
6. Describe types of air stream loading and manifold systems.
7. Describe styles of packing systems and their applications.
8. Compare air systems to gravity systems.
9. Calculate in-field calibrations.
10. Perform stationary calibrations.
11. Describe repairs to seeding equipment (planters).
12. Describe repairs to air seeding equipment.
13. Perform adjustments and repairs to air seeding equipment.

B. Workplace Coaching Skills ..... 5 Hours

Outcome: Explain coaching skills and the purpose of the Advisory Network.

1. Describe the coaching skills used for training apprentices.
2. Explain the role and purpose of the advisory network.

SECTION SIX: ..... BRAKING SYSTEMS ..... 24 HOURS

A. Hydraulic Brakes System Fundamentals ..... 3 Hours

Outcome: Apply scientific principles to braking system operation.

1. Explain braking principles with emphasis on hydraulic forces, friction and heat.
2. Describe the properties and handling procedures of brake fluids.

B. Hydraulic Brake Systems (Drum and Disc)..... 7 Hours

Outcome: Explain the operation of hydraulic drum and disc brake systems.

1. Explain the principles of operation of drum brake systems.
2. Explain the principles of operation of disc brake systems.
3. Explain the construction and operation of master cylinders.
4. Explain the purpose and construction of brake lines and hoses.
5. Explain the construction and operation of wheel cylinders and calipers.
6. Explain the purpose and operation of valves.

C. Hydraulic Brake System Diagnosis and Service ..... 7 Hours

Outcome: Service hydraulic drum and disc brake systems.

1. List safety responsibilities required when servicing and repairing brake systems.
2. Diagnose brake systems faults.
3. Service a drum brake assembly.
4. Service a disc brake assembly.
5. Describe reconditioning procedures required for hydraulic brake components.
6. Demonstrate brake flushing and bleeding procedures on hydraulic brake systems.

D. Hydraulic Brake Booster System Fundamentals and Service ..... 7 Hours

Outcome: Explain power braking systems service procedures.

1. Identify common power assist braking systems.
2. Explain the principles of operation for vacuum brake booster systems.
3. Describe the diagnosis and repair procedures for vacuum brake booster systems.
4. Explain the principles of operation for air over hydraulic brake booster systems.
5. Describe the diagnosis and repair procedures for air over hydraulic brake booster systems.
6. Explain the principles of operation for hydraulic over hydraulic brake booster systems.
7. Describe the diagnosis and repair procedures for hydraulic over hydraulic brake booster systems.

SECTION SEVEN: ..... PRECISION FARMING SYSTEMS ..... 39 HOURS

A. GPS Mapping..... 12 Hours

Outcome: Explain the application of GPS Mapping as it pertains to precision farming techniques, taking field variability into account.

1. Describe GPS system operation relating to the space, user and control segment.
2. Describe basic datum measuring systems and units used in GPS.
3. Record waypoints and lines in a field mapping exercise with a handheld GPS unit.
4. Create a map on a computer after downloading a GPS unit.
5. Assess selected types of differential correction systems used to enhance GPS accuracy.

B. Yield Monitors ..... 8 Hours

Outcome: Explain the application of Yield Monitors as it pertains to precision farming techniques, taking field variability into account.

1. Describe yield mapping equipment for combines.
2. Set-up a yield monitor utilizing a laptop computer and PC card interface.
3. Compare yield map details displaying raw data and smoothed data.
4. Query a yield map for average and site specific details.
5. Diagnose basic operating problems of a yield mapping system.

C. Variable Rate Application ..... 8 Hours

Outcome: Explain the application of Variable Rate Application as it pertains to precision farming techniques, taking field variability into account.

1. Describe variable rate technology (VRT) for crop inputs.
2. Compare the differences between manual variable rate and map based variable rate systems.
3. Describe basic controller functions relating to setup, calibration, sensor input and operator readout information.
4. Program a variable rate monitor to control an air drill.
5. Calibrate a variable rate applicator for seed or fertilizer.
6. Diagnose basic operating problems of a variable rate applicator.

D. Monitors and Sensors ..... 4 Hours

Outcome: Identify features of monitoring systems and controller area networks.

1. Describe the function of performance monitors.
2. Describe the basic operating principles of the CAN-BUS (Controller Area Network).
3. Record diagnostic and warning messages produced by a CAN-BUS system.

E. GPS Steering Guidance Systems ..... 7 Hours

Outcome: Identify GPS steering guidance systems.

1. Identity the types of steering guidance systems.
2. Describe the operation of GPS steering guidance systems.
3. Describe the setup of a guidance system.

FOURTH PERIOD TECHNICAL TRAINING
AGRICULTURAL EQUIPMENT TECHNICIAN TRADE
COURSE OUTLINE

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SECTION ONE: .....ADVANCED HYDRAULICS .....114 HOURS

A. Hydraulic Principles.....9 Hours

Outcome: Explain principles of hydraulics.

1. Explain the principles of hydraulic energy transfer.
2. State the characteristics of hydraulic oil.
3. Explain common hydraulic contamination control methods.

B. Hydraulic Pump Fundamentals.....9 Hours

Outcome: Identify common hydraulic pumps.

1. Explain common hydraulic pump configurations.
2. Explain gear pump operating principles.
3. Explain vane pump operating principles.
4. Explain piston pump operating principles.

C. Hydraulic Pump Service .....12 Hours

Outcome: Diagnose and repair common hydraulic pumps.

1. Explain start up procedures and precautions.
2. Service a gear pump.
3. Service a vane pump.
4. Service a piston pump.

D. Hydraulic Actuator Fundamentals.....6 Hours

Outcome: Identify hydraulic cylinders and motors.

1. Explain the operating principles of hydraulic cylinders.
2. Explain the operating principles of hydraulic motors.

E. Hydraulic Actuator Service .....9 Hours

Outcome: Service hydraulic cylinders and motors.

1. Service hydraulic cylinders.
2. Service hydraulic motors.

F. **Hydraulic Valve II** ..... **18 Hours**

Outcome: Service hydraulic pressure, flow and directional control valves.

1. Explain the operation and service procedures of hydraulic pressure control valves.
2. Explain the operation and service procedures of hydraulic flow control valves.
3. Explain the operation and service procedures of hydraulic directional control valves.
4. Explain the operation and service procedures of directional control valve accessories.
5. Explain methods used to connect multiple directional control valves.

G. **Hydraulic System Types** ..... **18 Hours**

Outcome: Analyze common mobile equipment hydraulic systems.

1. Interpret common mobile equipment hydraulic system schematics.
2. Explain the operation of mobile open centre hydraulic systems.
3. Explain the operation of mobile closed centre hydraulic systems.
4. Explain the operation of a mobile hydrostatic transmission hydraulic system.

H. **Hydraulic System Testing And Service** ..... **18 Hours**

Outcome: Diagnose common mobile equipment hydraulic systems.

1. Perform visual inspection and operational tests on common hydraulic systems.
2. Perform pressure and flow testing on common hydraulic systems.
3. Determine hydraulic system faults.

I. **Electro-Hydraulics** ..... **15 Hours**

Outcome: Analyze basic electrical and electronically controlled hydraulic systems.

1. Explain the operation principles of electrically controlled hydraulic system components.
2. Explain the operating principles of electronically controlled hydraulic system components.
3. Explain joystick and pulse width modulated control systems.
4. Diagnose electro hydraulic system faults.

SECTION TWO:..... STEERING AND SUSPENSION SYSTEMS & ACCESSORIES ..... 34 HOURS

A. **Wheeled Equipment Steering Fundamentals And Service** ..... **10 Hours**

Outcome: Diagnose and service off-road equipment steering systems.

1. Identify common off-road steering configurations and applications.
2. Identify full time power steering system components.
3. Explain the operation of common off-road power steering systems and components.
4. Explain off-road power steering system diagnostic and service procedures.
5. Identify skid steering system components.
6. Explain the operation of a skid steering system.
7. Explain skid steering system diagnostic and service procedures.

B. Suspension System Fundamentals And Service ..... 6 Hours

Outcome: Explain off-road suspension system diagnostic and service procedures

1. State the functions and applications of common off-road suspension systems.
2. Explain the operation of a motor scraper cushion hitch system.
3. Explain cushion hitch diagnostic and service procedures.
4. Explain the operation of common haul truck suspension systems.
5. Explain common haul truck suspension system diagnostic and repair procedures.

C. Off-road Equipment Accessories And Attachments ..... 6 Hours

Outcome: Service and maintain accessories and attachments used with off-road equipment.

1. Explain the functions and operating principles of operator protective structures.
2. Explain operator protective structures in regards to service and maintenance precautions.
3. Identify and explain the purpose of automatic fire suppression systems used on off-road equipment.
4. Identify and explain the functions of common ground engaging tools and tool mounting components.
5. Explain the procedures required to service common ground engaging tools.
6. Explain the operating principles and service procedures required for common types of winches.

D. Off-road Electrical Circuit Fundamentals ..... 6 Hours

Outcome: Explain the operation of typical off-road equipment electrical and warning circuits.

1. Explain the operation of off-road equipment lighting circuits.
2. Explain the operation of off-road equipment accessory circuits.
3. Explain the operation of audible and visual warning devices.

E. Off-road Electrical Circuit Service ..... 6 Hours

Outcome: Diagnose and repair off-road equipment electrical circuits.

1. Perform basic test procedures on off-road equipment lighting circuits.
2. Perform basic test procedures on off-road equipment accessory circuits.
3. Explain precautions when servicing electronic dash systems.

SECTION THREE: ..... POWER TRAIN III ..... 92 HOURS

A. Gearing Principles ..... 3 Hours

Outcome: Explain basic gearing principles.

1. Define gear terminology.
2. Explain gear relationships with regards to ratios and input/output direction.
3. Identify common gear types and applications.

B. **Torque Converter Fundamentals And Service** ..... **9 Hours**

Outcome: Diagnose and repair common off-road equipment torque converters.

1. Describe the function and concepts of fluid converters.
2. Describe the components and operation of torque converters.
3. Explain the operation of a torque divider.
4. Explain basic torque converter mounting, diagnostic and repair procedures.

C. **Powershift And Automatic Transmission Mechanical/Electronic Components** ..... **14 Hours**

Outcome: Explain the operation of powershift and automatic transmissions mechanical components.

1. Compare functions and applications of powershift and automatic transmissions.
2. Explain gearing principles of single and multiple planetary gear seats.
3. Explain the operation of a typical planetary type transmission.
4. Explain the operation of typical countershaft type powershift/automatic transmissions.

D. **Powershift and Automatic Transmission Control and Shifting** ..... **10 Hours**

Outcome: Explain the operation of powershift and automatic transmission shift control mechanisms.

1. Explain the operation of hydraulic shift control systems for powershift transmissions.
2. Explain the operation of hydraulic shift control systems for automatic transmissions.
3. Explain the operation of electronic shift control systems for automatic transmissions.

E. **Hydraulic Retarder Fundamentals** ..... **3 Hours**

Outcome: Explain the operating principles for off-road equipment hydraulic retarders.

1. Identify the components of a typical off-road equipment hydraulic retarder.
2. Explain the operation of a typical off-road equipment hydraulic retarder.

F. **Powershift And Automatic Transmission Testing And Service** ..... **10 Hours**

Outcome: Diagnose and service powershift and automatic transmissions.

1. Perform powershift and automatic transmission visual inspections and operational tests.
2. Perform powershift and automatic transmission hydraulic shift control system testing.
3. Perform powershift and automatic transmission electronic shift control system testing.
4. Explain the procedures to remove and reinstall a powershift and automatic transmission.

G. **Tracked Equipment Steering Fundamentals And Service** ..... **11 Hours**

Outcome: Explain tracked equipment steering system diagnostic and service procedures.

1. Explain the operation of a steering clutch and brake crawler tractor steering system.
2. Explain the diagnostic and service procedures for a steering clutch and brake crawler tractor steering system.
3. Explain the operation of a hydrostatic crawler tractor steering system.
4. Explain diagnostic and service procedures for a hydrostatic crawler tractor steering system.

5. Explain the operation of a differential type crawler tractor steering system.
6. Explain the diagnostic and service procedures for a differential type crawler tractor steering system.

H. Undercarriage Systems Fundamentals And Service ..... 11 Hours

Outcome: Explain diagnostic and service procedures for tracked equipment undercarriage and related components.

1. Describe the functions, applications and configurations of undercarriage systems.
2. Explain the functions and operation of the components of typical undercarriage systems.
3. Perform undercarriage inspection and adjustment procedures.
4. Explain the procedures required for safely removing and replacing undercarriage components.
5. Explain procedures for remanufacturing undercarriage components.

I. Final Drive Fundamentals And Service (off road) ..... 6 Hours

Outcome: Explain diagnostic and service procedures for off-road equipment final drive systems.

1. Describe the functions, applications, and configurations of drive systems.
2. Explain the operation of wheeled equipment final drive systems.
3. Explain the operation of tracked equipment final drive system.
4. Explain maintenance and service procedures for final drive systems.

J. Drive Axle and Differential Fundamentals and Service (off road) ..... 12 Hours

Outcome: Repair drive axle and differential assemblies.

1. State the functions of single reduction drive axle assemblies.
2. Identify single reduction drive axle components.
3. Explain the operating principles of a single reduction drive axle and differential assembly.
4. Identify common types of differential units used in the trade.
5. Explain the lubrication of a single reduction drive axle.
6. Diagnose a drive axle and differential assembly for operational faults.
7. Explain drive axle and differential assembly removal and replacement procedures.
8. Overhaul a typical drive axle and differential assembly to manufacturer's specifications.

K. Clutch Fundamentals And Service ..... 3 Hours

Outcome: Service and diagnose common clutch types.

1. Explain the operation and maintenance of over-centre clutches.
2. Explain the operation principles of special application clutches: overrunning, dog, cone and bevel, electromagnetic.

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